Safely Operating in Dynamic Scenarios ADS Demonstration Grant

Program Overview

Virginia Tech Transportation Institute

Program Overview

5-27-2020

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CAMP LLC
Safely Operating Automated Driving Systems in Challenging Dynamic Scenarios (SOADS-CDS)

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Virginia Tech Transportation Institute

- This is our 31st year
- Largest transportation research institute in the U.S. by most metrics
- Safety focus
- 300+ projects, 40+ proprietary projects
- ~520 total employees on "payroll" at any given time
  - 300 full-time
  - 300 students funded for at least part of a year
- Participation from over 150 VT faculty in the last few years

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SAE Levels of Automation

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation

0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Work Zones and Crash Scenes Present Challenges for Automation

- Temporary, unconventional layout
  - Alteration of roadway
  - Level of standardization depends on operator and jurisdiction
  - Detailed data may be fragmented or unavailable
  - Real time HD maps
- Audio, visual, and gesture commands may be given onsite
- Novel pathfinding directions – driving against rules may be required
- Chaotic scenes with debris, random vehicle orientations, unexpected pedestrian activity
- Emergency lighting, fire, dust, smoke, etc. may affect sensor perception

Image Source: FHWA

FHWA ADS Demo NOFO Overview

- Focus
  - Demonstrate L3+ ADS technologies and obtain targeted deployment feedback
  - Evaluate and identify key aspects for the safe integration of ADS into the Nation’s on-road transportation
- Goals
  - Demonstrate the safe integration of ADS into the Nation's transportation system
  - Inform safety analysis and rulemaking with data
  - Create a collaborative environment that harnesses the collective expertise to advance the deployment of ADS
- Awards
  - USDOT made 8 awards, $60M total awards
  - Up to 4 year duration

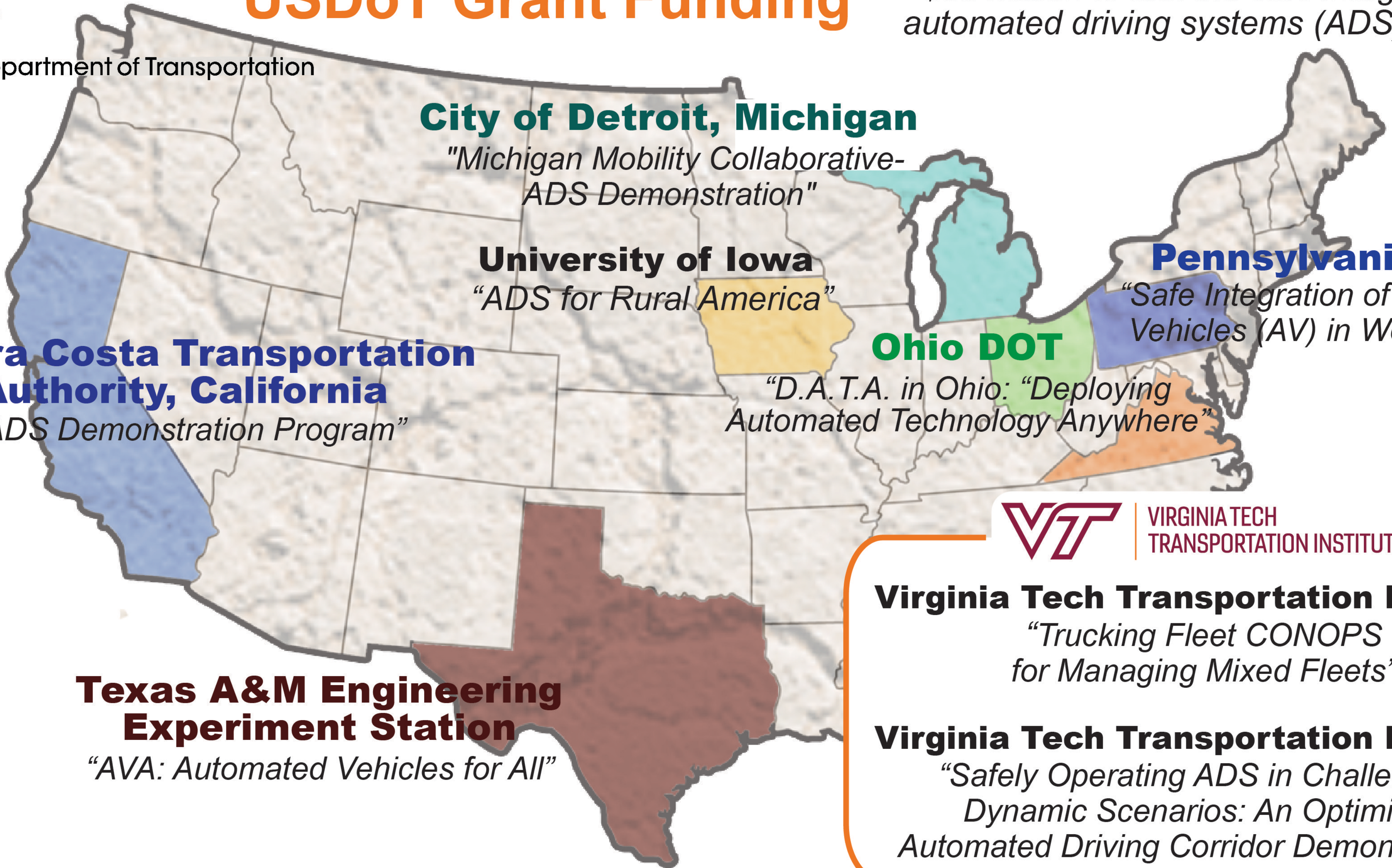
USDOT Goals and Focal Areas of Program

- Improve Safety
- Foster Collaboration
- Data for rule making and system development
- Significant public benefit
- Addressing an area where the market may not develop in isolation
- Fostering economic vitality
- Developing complex technology
- Contributing to a diverse set of ADS projects at the USDOT
- Addressing transportation-challenged populations
- Developing prototype systems

USDoT Grant Funding

U.S. Department of Transportation

~$60 million to test the safe integration of automated driving systems (ADS)



City of Detroit, Michigan
"Michigan Mobility Collaborative-ADS Demonstration"

University of Iowa
"ADS for Rural America"

Contra Costa Transportation Authority, California
"ADS Demonstration Program"

Ohio DOT
"D.A.T.A. in Ohio: "Deploying Automated Technology Anywhere"

Pennsylvania DOT
"Safe Integration of Automated Vehicles (AV) in Work Zones"

Texas A&M Engineering Experiment Station
"AVA: Automated Vehicles for All"

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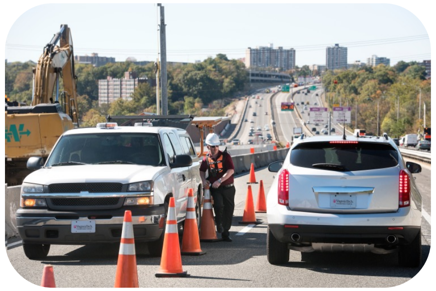
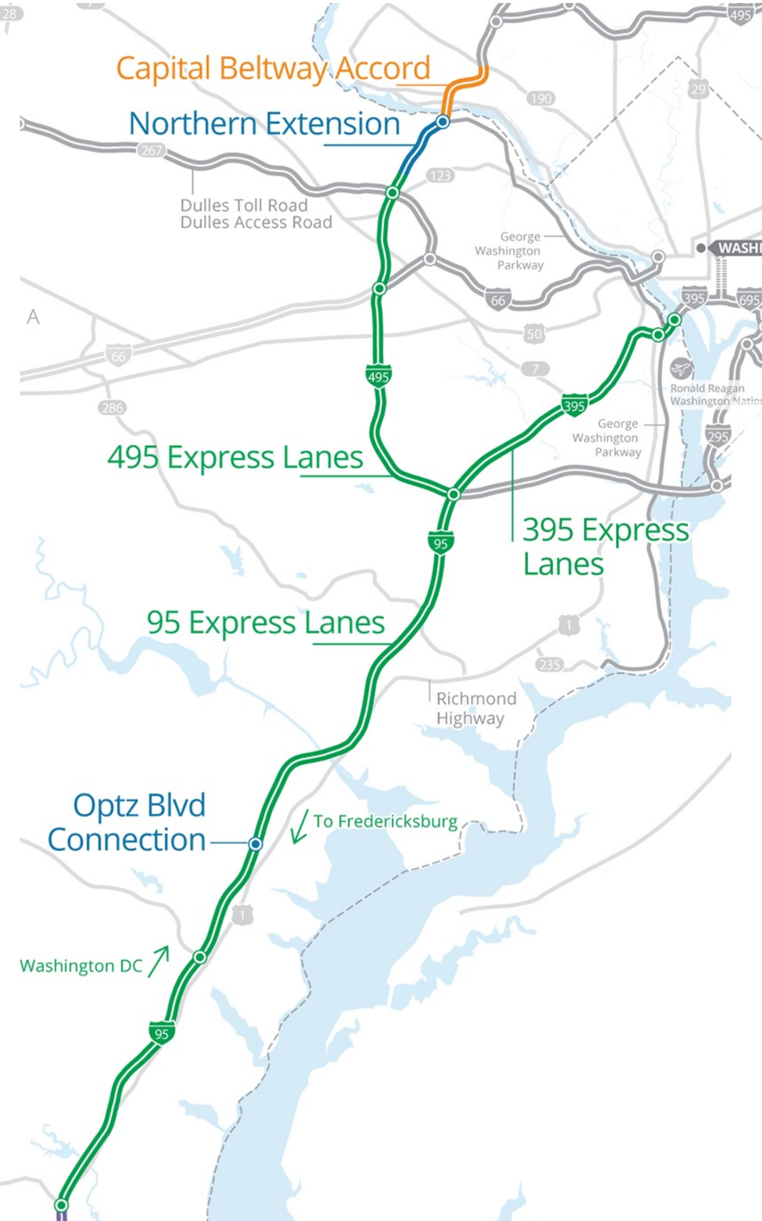
Virginia Tech Transportation Institute
"Trucking Fleet CONOPS for Managing Mixed Fleets"

Virginia Tech Transportation Institute
"Safely Operating ADS in Challenging Dynamic Scenarios: An Optimized Automated Driving Corridor Demonstration"

Our Demonstration Concept

Safe L4 ADS Interactions with Public Services





Cooperative L3+ ADS Operation on a Managed Corridor

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Partners

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Rationale

Interaction with public services is a key aspect to the safe integration of ADS-equipped vehicles on roadways

The mobility benefits of ADS-equipped vehicles may only be realized through cooperative operations

Collaboration

OEMs and ADS Developers

Are there opportunities to improve ADS interaction with public safety operations?

Infrastructure Owner Operators

How can we facilitate safe ADS deployment?

Public Safety Providers

How should we interact with ADS and how will they respond?

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- Build consensus on requirements and technological solutions
- Leverage infrastructure data to ensure safe ADS operation
- Develop L4 ADS capabilities to demonstrate safe interactions, cooperative operation, and collect data
- Create simulations of interactions and distribute data to OEMs and ADS developers
- Develop recommendations, data, and educational materials for OEMs, IOOs, and Public Safety Providers

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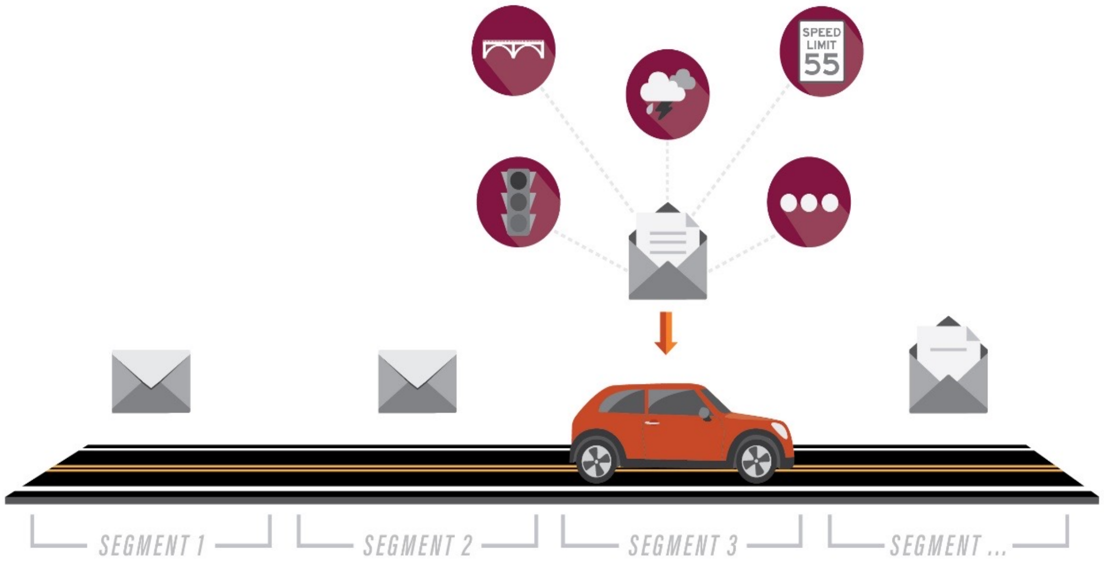
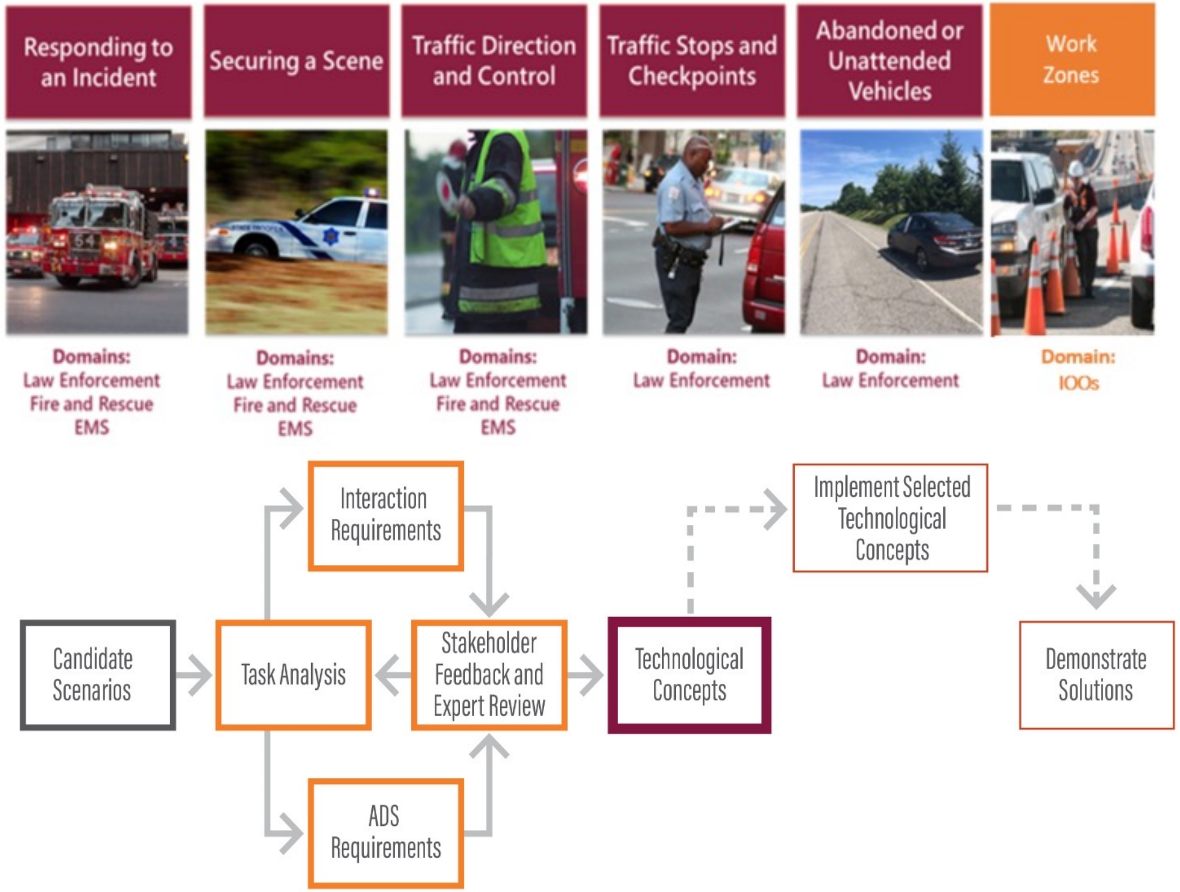
Task 1: Develop Solutions for Corridor Optimization

- Evaluate Express Lanes for Demo
  - Communications requirements and technology options
  - Assess signage, striping, TOC capability, etc.
- Develop spec for real time Operational Design Domain (ODD) support system
  - Investigate source data available
  - Develop messages to provide data to vehicles
  - OEM stakeholder review of messages and content
  - Spec architecture for message flow and management
  - Spec full ODD TOC-side tool
- Develop high-level CADS demo concept
  - Dynamic speed harmonization solution with CACC
  - High level vehicle-side requirements to support demo



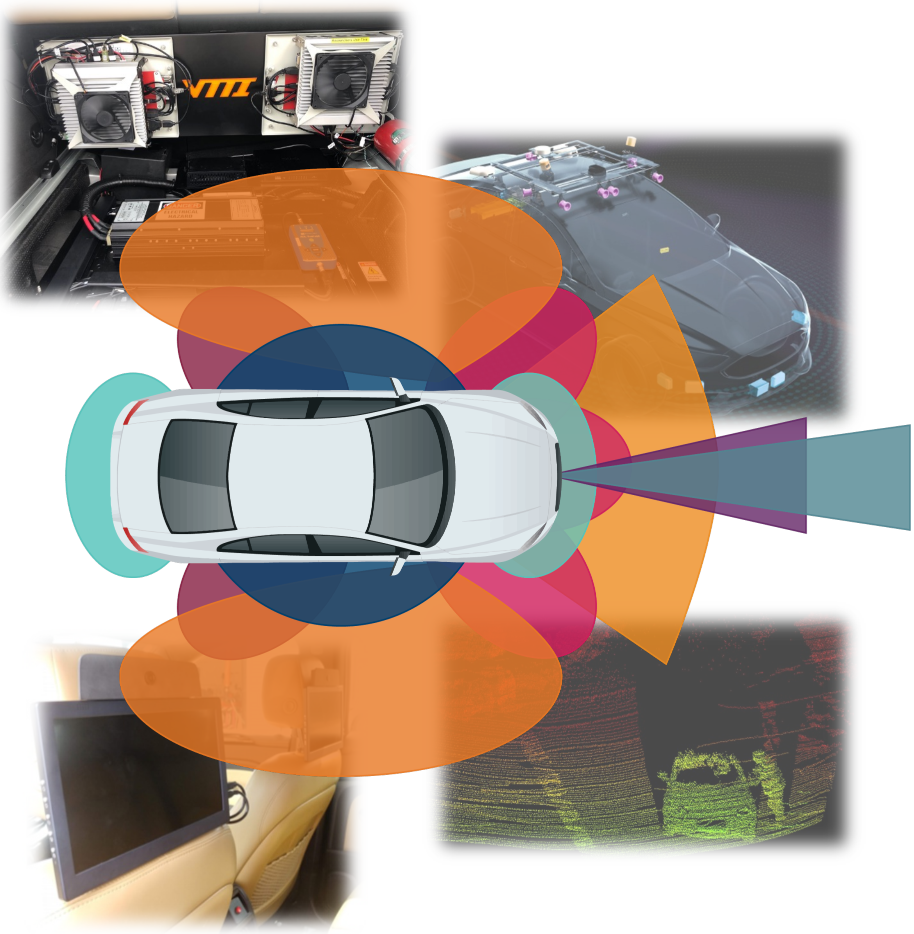
Task 2: Dynamic Scenario Definition and Development of Technological Solutions

- Extend existing task analysis to support SSP and Work Zone use cases (VTTI)
- Candidate scenarios
- Interaction requirements
- Technological concepts
  - Scan for available technologies or development opportunities
  - Cost/feasibility/practicality/acceptance, etc.
- ADS requirements to support technological concepts
- Public safety requirements to support technological concepts



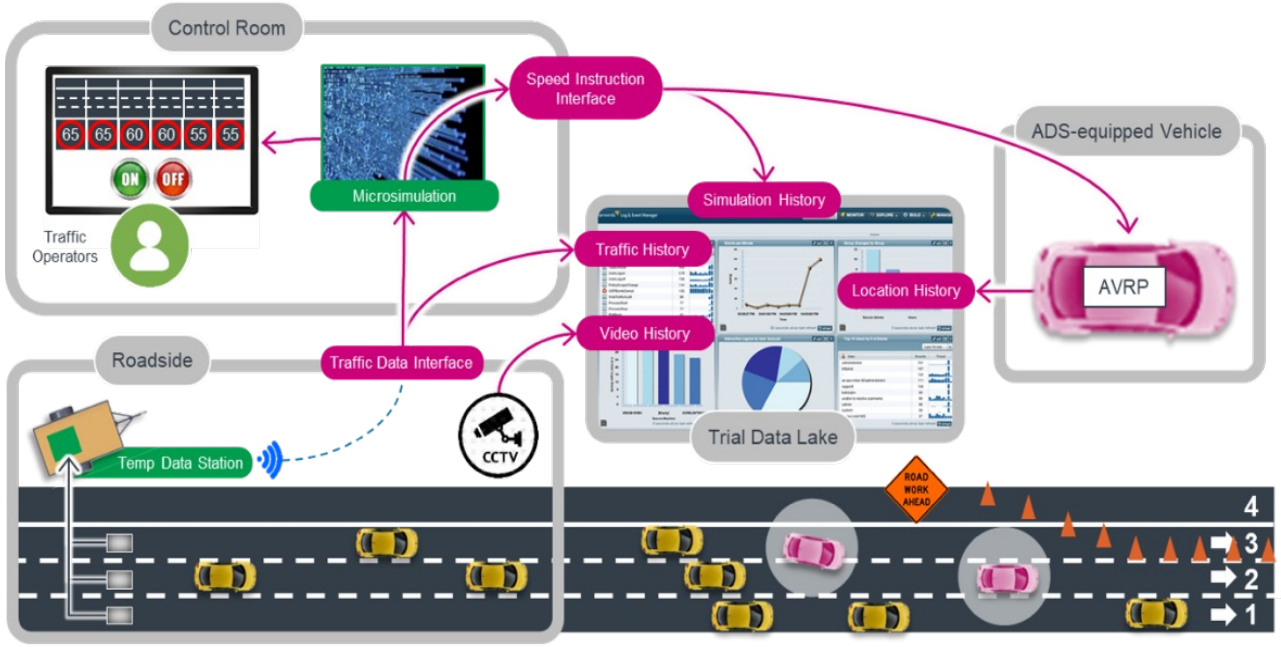
Task 3: Build Reference Demonstration Vehicles

- Vehicle platform goals
  - Capable of performing L4 operation within the ODD of the selected scenarios
  - Capacity for ride-along participants
  - Significant data collection capability
- Platform selection
  - Significant time has passed since proposal
  - New options are available
  - Evaluate CARMA to identify opportunities to incorporate
- Build and test the vehicle(s) for selected scenarios



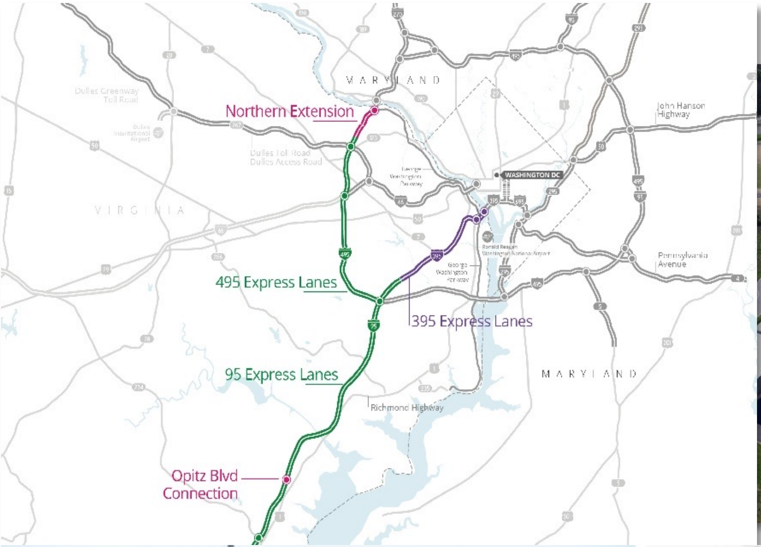
Task 4: Build TOC Applications

- Build and test ODD support tool specified in Task 1
  - Traffic conditions
  - Weather
  - Work zones
  - Incidents
  - Build upon AMCD/EDCM concepts
- Dynamics speed harmonization application
- Build and test TOC side of cooperative automation applications
  - Recommended speed
  - Recommended lane selection
  - Platoon configuration



Task 5: Design and Conduct Demonstrations

- Three high profile demonstration events
  - Northern VA and possibly Smart Road in Blacksburg, VA
  - Primary stakeholder groups include IOO's, OEM's, Public Safety Providers
  - On-road, parking lot, and test track options
  - Staged scenarios and events
- Participation from public safety partners
- Focus group sessions



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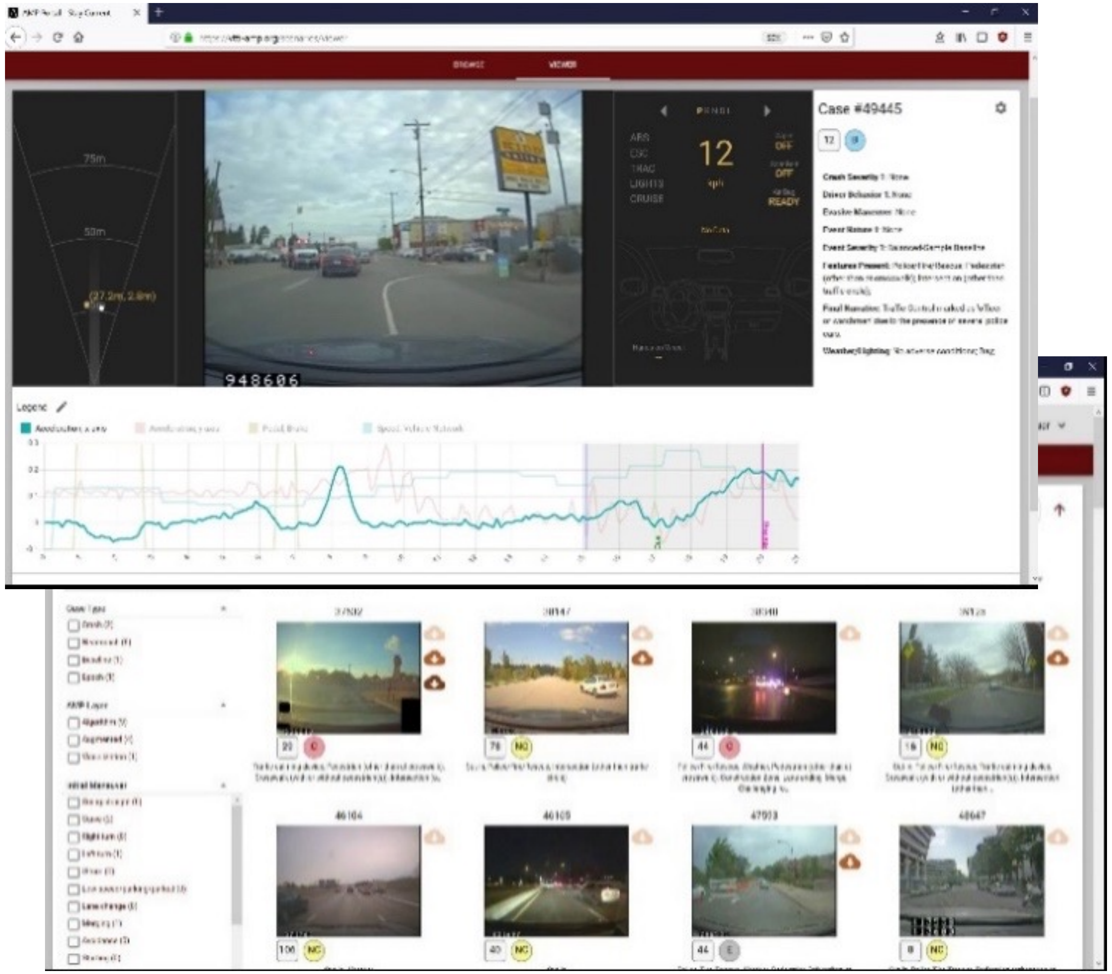
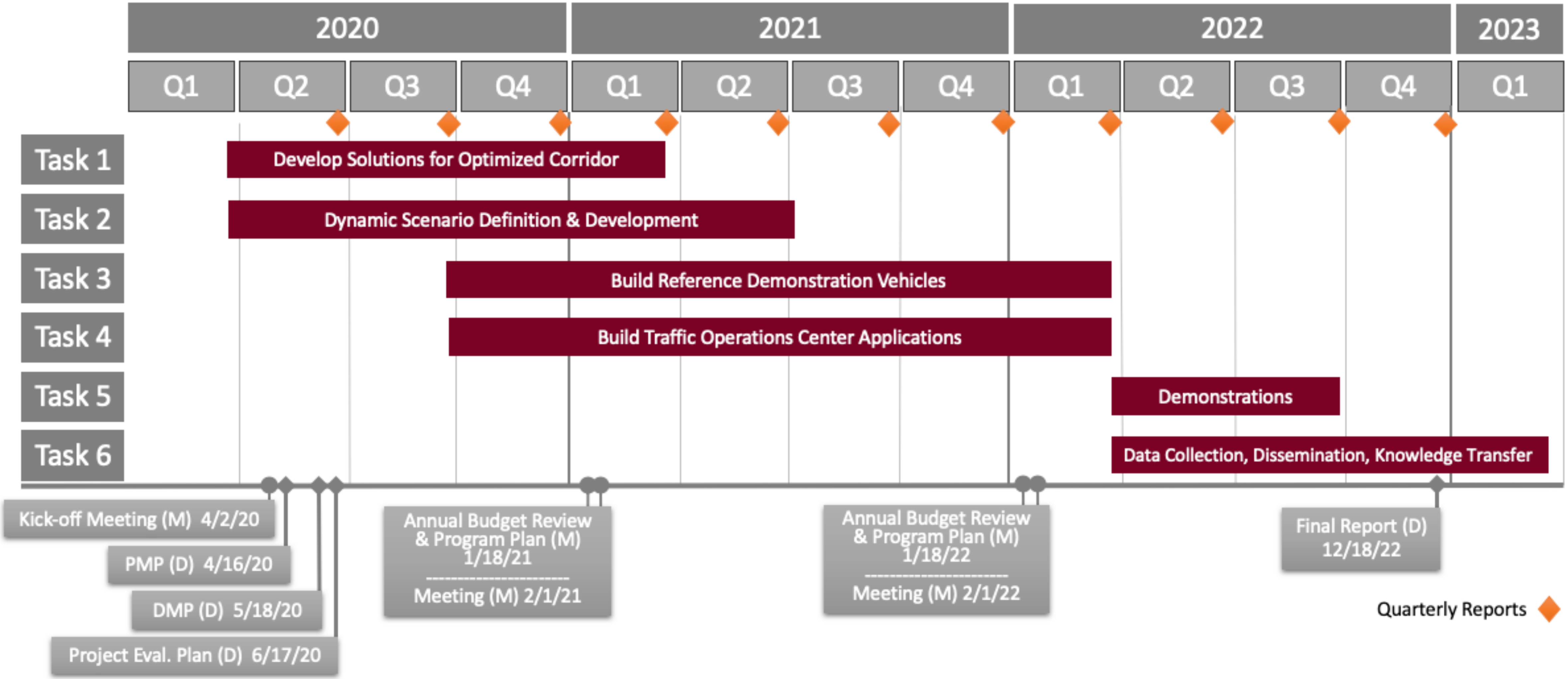
Task 6: Data Collection, Processing, and Dissemination

- Data collected during testing and demonstrations will be processed into several datasets
  - On-board DAS
  - Scenario demonstration
  - Scenario simulation
  - Infrastructure data
  - Subjective assessment
- Source data for ADS development and public safety training
- Hosted on portal for public access



Timeline



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Questions?

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